# NOTE ON CELL CHANGES IN A CASE OF COMPLETE COMPRESSION OF THE CORD.[1]

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The mode of connection between neurones, whether motor or sensory, is still one of the unsettled questions of the finer anatomy of the nervous system. In intimate relation to this question is that of the effect of destruction of one neurone upon the nutrition and structure of those which are in connection with it. The case presented today seemed to me peculiarly fitted for the study of changes in the peripheral motor neurone when the axis cylinder of the central neurone has been completely destroyed, and this both because the destruction of the motor neurone of the second order was unusually complete, and also because of the long duration of the symptoms, for a period of thirteen years.

The case was presented to this Association at its meeting in Washington two years ago[2], and a brief résumé of the clinical features of the case will suffice.

The case was one of endothelioma of the dura. The patient, a single woman, at the age of twenty-one, in June, 1884, began to lose the use of the legs. In October she could still walk with assistance, but in April, 1885, she had no power in the legs, though the arms were unaffected. There was incontinence of urine at this time. In September, 1887, it was noted that there were violent, spasmodic and sudden contractions in the limbs. In November of that year there were noted flexor contractures in the legs. In August, 1892, it was noted in the records that there was no sensation in the legs, and no perception of pain. The cranial nerves were not affected, and although the pupils were pretty constantly dilated they reacted to light and upon accommodating. The upper extremities were not affected, while the lower ones showed extreme contractures and were atrophied to a marked degree. The reflexes were not obtainable on account of the contractures. Sensibility in all forms was lost to a level on the trunk at about the mid-dorsal region. The function of the vesical and rectal sphincters was completely abolished. Decubitus was present. Exitus from exhaustion occurred on April 19, 1898. Autopsy by Dr. R. M. Pearce on April 19, 1898. The decubitus and contractures of the lower limbs were noted. In the mid-dorsal region of the vertebral column there was a projecting knuckle formed by the spinous processes of two vertebræ. Upon removing the cord there was found below the cervical enlargement and at the level of the spine of the scapula a granular, reddish swelling of the dura, about 2.5 cm. in length. This tumor appeared to be meningeal, but had almost completely replaced the cord. Below this point the cord appeared considerably atrophied. There was no lesion of the cord opposite the vertebral knuckle. Besides the conditions just spoken of, there was found diffuse nephritis, and cystitis. The microscopical examination of the tumor showed it to be an endothelioma of the dura, with the peculiar concentric rings seen in the tumors called psammomata. This tumor had produced what was practically a complete compression of the cord in the mid-dorsal region, the only axis cylinders which retained their myelin sheaths being a very few scattered ones at the periphery of the cord, and a few at the periphery in the posterior columns. There was a marked increase of the neuroglia in this part of the cord. Above the point of compression the cord showed marked degeneration of the median part of the posterior columns, and of the direct cerebellar tracts, and a more diffuse degeneration of the periphery of the cord throughout the lateral border and along the anterior fissure. Below the point of compression the cord was smaller than normal, and there was a well marked indentation just anterior to the point of exit of the posterior nerve roots. There was a very marked degeneration of the lateral and anterior pyramidal tracts, and a moderate diffuse degeneration at the periphery of the cord in its anterior and lateral

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[1] Read at the annual meeting of the American Neurological Association, June 5, 6 and 7, 1902.

[2] Thomas, J. J., "Two Cases of Tumor of the Spinal Cord." JOURNAL OF NERVOUS AND MENTAL DISEASE, November, 1900.

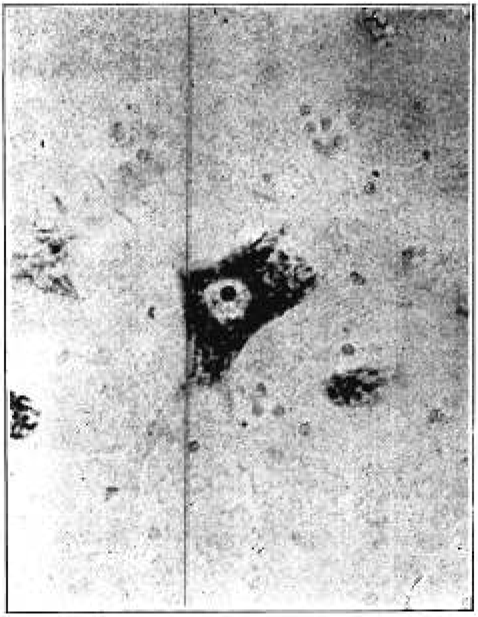

Plate I.

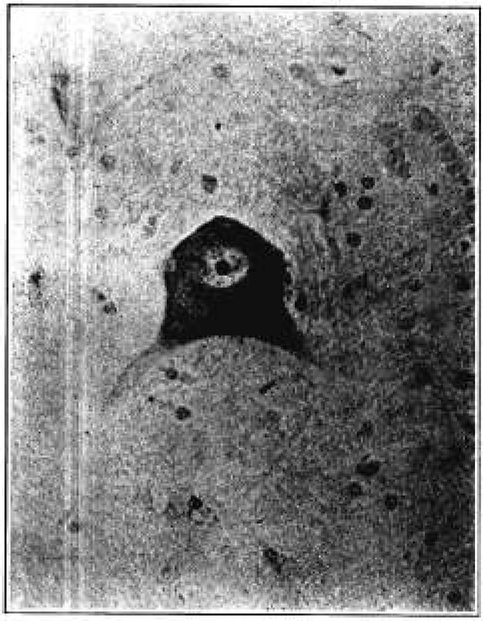

Plate III.

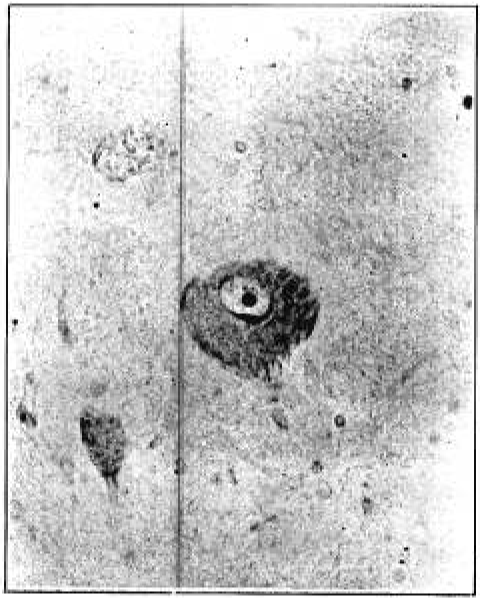

Plate II.

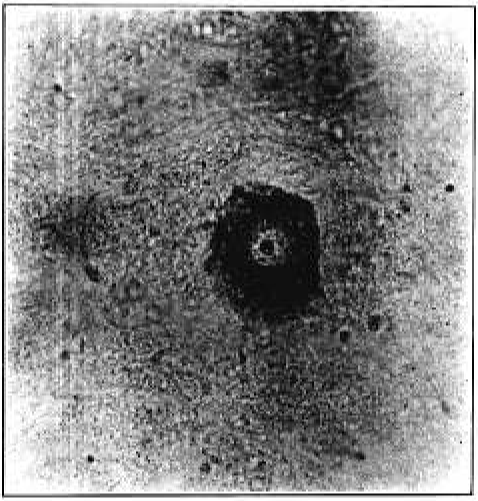

Plate IV.

Description of Plates:

Plate 1—Cells from the ventral horn of the lumbar enlargement. Magnification about 250 diameters. Nissl's stain. Normal cell.

Plate 2—Do. Cell showing almost complete destruction of the chromophilic granules. Irregularity of nuclear membrane.

Plate 3—Do. Cell showing diffuse staining of the cytoplasm. Poorly staining nuclear membrane.

Plate 4—Do. Cell with diffuse staining of the cytoplasm and advanced nuclear changes. Vacuolization of nucleolus.

parts, and a very slight diffuse degeneration throughout the anterior ground bundle. The degeneration at the periphery of the cord was no longer seen at the lower part of the thoracic cord, though the degeneration of the motor tracts, both lateral and anterior, was well marked here, as also that of the lateral pyramidal tract in the lumbar cord after the anterior tract had ended.

Since writing the previous report of this case a portion of the lumbar enlargement of the cord, which was hardened in formalin, was embedded in paraffine and stained with methylene blue by Nissl's method. The large motor cells of the ventral horn of the lumbar enlargement show occasional cells in which the chromophilic granules appear normal. These are irregular in shape, with distinct outlines, leaving the axonal hillock free, and they can be traced into the protoplasmic processes of the cell for fully the normal distance. The nucleus is clear and the nuclear membrane distinct. In some of the cells the nucleolus appears slightly swollen, and stains irregularly, and takes a slightly purplish tinge with the methylene blue stain. These normal cells are on the average two or three in each section of the cord. The remaining cells of the ventral horns show well marked changes. In most of them the granules at the periphery of the cell appear normal, and can be traced as usual well into the dendritic processes. The cell processes appear normal also. About the nucleus and filling the whole central part of the cell cytoplasm are very fine granules, in many cases so fine as to give merely a faint bluish tinge to the protoplasm about the nucleus. The axonal hillock can usually not be seen distinctly and seems to contain the same fine granular dust. The nuclear membrane is either very indistinct, or, as is more usually the case, the outline of this membrane is extremely irregular, so that in places it cannot be seen at all, and at other parts of the periphery there is a heaping up of chromatin substance which makes an irregular mass at one or two points of the border of the nucleus. The body of the nucleus is as a rule quite clear. The nucleolus is as a rule larger than normal, and generally vacuolated, and has a distinct purplish tinge. The nucleus, as a rule, occupies the normal position in the center of the cell-body, but occasionally it is placed slightly excentrically, and in a good many instances the nucleolus is placed much nearer the periphery of the nucleus than is normally the case. In many of these cells is seen an area, sometimes a quarter or a third of the area of the cell, which is clear from granules or granular dust, and is of a yellowish color. This is apparently caused by an increase of the pigment granules of the cell, though the granules themselves are not distinctly seen even with a high power immersion lens. The few small nerve-cells at the base of the dorsal horn at this level of the cord appear practically normal.

We have in this case, to summarize, a tumor of the dura which produced a complete compression of the cord, resulting in a complete paraplegia with the formation of marked contractures and an entire loss of all forms of sensation, and loss of the control of the bladder and rectum, which condition lasted for thirteen years. There was a general smallness of the cord below the point of compression, and the usual systemic degeneration of the pyramidal tracts. The large motor cells of the ventral horn of gray matter in the lumbar enlargement were in a considerable number of cases found to show no changes in the chromatic substance as studied by Nissl's staining method. The larger number of these cells, on the other hand, showed well marked changes, consisting in a central chromatolysis, together with marked nuclear changes, as shown by the disappearance of the nuclear membrane and the heaping up of the chromatin substance at one point at the border of the nucleus, as well as by the slighter changes occasionally found where the nucleus took a diffuse stain with the methylene blue, or where there was swelling and irregular staining of the nucleolus.

It is difficult to imagine a case more suited than this to the elucidation of the question of possible changes in the peripheral neurone secondary to destruction of the cerebral neurone, the so-called reaction at a distance, both because of the long duration of the condition, and the completeness of the interruption of conduction through the cord of all impulses, as shown both by the symptoms during life, and by the results of the microscopical examination of the cord. The conclusions which seem to be justified may appear somewhat contradictory, but they certainly seem to be that a central chromatolysis and nuclear changes of quite a severe grade may occur in nerve cells of the ventral horn when interruption of conduction from the brain of motor impulses has been cut off for a long time; and second, that in spite of this interruption of conduction from the central neurones the peripheral motor nerve cell may retain its normal cytoplastic appearance for many years.

Perhaps the most obvious inference from these facts is that recovery from the symptoms produced by a compression of the cord from without, as from a tumor of the dura as in this case, is probably possible as far as the preservation of the peripheral neurones is concerned long after the entire loss of any hope of recovery of the central neurones after removal of the compression.